IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Response Under 37 C.F.R. § 1.116 Expedited Procedure

In re application of:

Larry C. Olsen et al.

Application No. 10/726,744

Filed: December 2, 2003

Confirmation No. 6833

For: THERMOELECTRIC DEVICES AND APPLICATIONS FOR THE SAME

Examiner: Jeffrey Thomas Barton

Art Unit: 1795

Attorney Reference No. 23-65037-01

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RESPONSE AFTER FINAL ACTION

This responds to the Office Action dated December 6, 2010. This Response is filed within two-months of the issue date of the Final Office Action. MPEP § 706.07(f)I.(C).

Please amend the referenced application as follows:

Amendments to the Claims are reflected in the listing of claims, which begins on page 2.

Remarks begin on page 6.

Listing of Claims

1. (Previously presented) A thermoelectric power source comprising:

a flexible substrate having an upper surface; and

a plurality of thermoelectric couples with the thermoelectric couples comprising:

(a) a co-sputter deposited thin film p-type thermoelement positioned on the upper surface of the flexible substrate;

(b) a co-sputter deposited thin film n-type thermoelement positioned on the upper surface of the flexible substrate adjacent the p-type thermoelement;

(c) an electrically conductive member positioned on the flexible substrate, and electrically connecting the first end of the p-type thermoelement with the second end of the n-type thermoelement, wherein the p-type or the n-type thermoelements comprise Bi_xTe_y, Sb_xTe_y, or Bi_xSe_y wherein x and y form a non-stoichiometric compound and wherein x is about 2 and y is about 3; and

wherein the thermoelectric couples are formed on a single substrate and the flexible substrate is in a coil configuration or an accordion configuration.

2. (Withdrawn) A thermoelectric power source comprising:

a flexible substrate having an upper surface; and

a plurality of thermoelectric couples with the thermoelectric couples comprising:

(a) a sputter deposited thin film p-type thermoelement positioned on the upper surface of the flexible substrate;

(b) a sputter deposited thin film n-type thermoelement positioned on the upper surface of the flexible substrate adjacent the p-type thermoelement;

(c) an electrically conductive member positioned on the flexible substrate, and electrically connecting the first end of the p-type thermoelement with the second end of the n-type thermoelement, wherein the p-type or the n-type thermoelements comprise Bi_xTe_y, Sb_xTe_y, or Bi_xSe_y wherein and x is about 2 and y is about 3;

wherein the thermoelectric couples are formed on a single substrate and the flexible substrate is in a coil configuration or an accordion configuration; and

wherein the p-type or the n-type thermoelements have L/A ratios from about 500 cm^{-1} to about 10,000 cm^{-1}.

3. (Previously presented) The thermoelectric power source of claim 1 wherein the p-type and the n-type thermoelements comprise Bi_xTe_y, Sb_xTe_y, and Bi_xSe_y, wherein x is about 2 and y is about 3.

4. (Canceled)

5. (Previously presented) The thermoelectric power source of claim 1 wherein the thermoelectric power source has a power output of from 50 μW to 1 W.

6. (Previously presented) The thermoelectric power source of claim 1 further comprising at least about 50 thermoelectric couples, wherein the thermoelectric power source has a power output of at least about 1 μW with a voltage of at least about 0.25 volt.

7. (Original) The thermoelectric power source of claim 6 wherein the p-type or the n-type thermoelements are at least about 1 mm in length and at least about 0.1 mm in width.

8. (Previously presented) The thermoelectric power source of claim 6 wherein the p-type or the n-type thermoelements are at least about 0.1 mm in thickness.

9. (Original) The thermoelectric power source of claim 1 further comprising at least about 1000 thermoelectric couples, wherein the thermoelectric power source has a power output of about 1 W with a voltage of at least about 1 volt.

10. (Previously presented) The thermoelectric power source of claim 1 wherein the p-type thermoelements each have a first width, the n-type thermoelements each have a second width, and the first width is different from the second width.

11. (Original) The thermoelectric power source of claim 1 wherein two or more p-type thermoelements are positioned and electrically connected in parallel with one another and the parallel positioned p-type thermoelements are electrically connected in series to n-type thermoelements.

12. (Previously presented) The thermoelectric power source of claim 1 wherein the thin film p-type thermoelements or the thin film n-type thermoelements comprise Bi_xTe_y and Sb_xTe_y, or Bi_xTe_y and Bi_xSe_y.

13. (Original) The thermoelectric power source of claim 1 wherein the volume of the thermoelectric power source is less than about 10 cm^3 and has a power output of from about 1 μW to about 1 W.

14. (Original) The thermoelectric power source of claim 1 wherein the volume of the thermoelectric power source is less than about 10 cm^3 and provides voltages of greater than about 1 volt.

15. (Original) The thermoelectric power source of claim 14 wherein the thermoelectric power source produces power at temperature differences of about 20°C or less.

16. (Original) The thermoelectric power source of claim 1 wherein two or more n-type thermoelements are positioned and electrically connected in parallel with one another and the parallel positioned n-type thermoelements are electrically connected in series to p-type thermoelements.

17. (Previously presented) The thermoelectric power source of claim 1 wherein the n-type or the p-type thermoelements-comprise Sb_xTe_y, Bi_xTe_y and Sb_xTe_y, or Sb_xTe_y and Bi_xSe_y.

18. (Previously presented) The thermoelectric power source of claim 1 wherein the n-type or the p-type thermoelements comprise Bi_xTe_y and Sb_xTe_y.

Claims 19 – 22 (Canceled)

23. (Withdrawn) A thermoelectric power source comprising:

multiple thermocouples electrically connected to one another on an upper surface of a-single flexible substrate, the thermocouples comprising:

sputter deposited thin film p-type thermoelements having thicknesses of 0.1 mm or greater;

sputter deposited thin film n-type thermoelements alternatingly positioned adjacent the p-type thermoelements, the n-type thermoelements having a thickness of about 0.1 mm or greater;

wherein the thermoelectric power source has a volume of less than about 10 cm^3 and has a power output of from about 1 μW to about 1 W generated by the thermocouples on the-single flexible substrate; and

wherein the p-type thermoelements or the n-type thermoelements comprise a Bi_xTe_y, Sb_xTe_y, or Bi_xSe_y alloy where x is about 2 and y is about 3.

24. (Withdrawn) The thermoelectric device of claim 23 wherein said multiple thermocouples electrically connected to one another are in series-parallel.

25. (Withdrawn) The thermoelectric power source of claim 23 wherein the p-type thermoelements have L/A ratios greater than about 500 cm^{-1}.

Claims 26 – 36 (Canceled)

37. (Previously presented) A thermoelectric power source comprising:

a flexible substrate having an upper surface; and

a thermoelectric couple comprising:

(a) alternating thin film p-type and n-type thermoelements positioned on the upper surface of the flexible substrate;

(b) an electrically conductive member positioned on the flexible substrate, and electrically connecting a first end of the p-type thermoelement with a second end of the n-type thermoelement, wherein the p-type or the n-type thermoelements comprise Sb_xTe_y or Bi_xSe_y wherein x is about 2 and y is about 3; and

(c) wherein the flexible substrate is in a coil configuration.

38. (Previously presented) The thermoelectric power source of claim 37 wherein the p-type thermoelements or the n-type thermoelements are at least about 1 mm in length and at least about 0.1 mm in width.

39. (Previously presented) The thermoelectric power source of claim 37 wherein the volume of the thermoelectric power source is less than about 10 cm^3 and has a power output of from about 1 μW to about 1 W.

Remarks

The claims pending in this application are 1-3, 5-18, 23-25 and 37-39; claims 2 and 23-25 have been withdrawn from consideration. No claims are amended herein. Reconsideration is respectfully requested.

The Examiner asserts identical rejections as presented in the prior Office Action (dated March 3, 2010). No new rejections are made, no new arguments asserted other than the Examiner's response to Applicant's last-filed arguments and Declaration filed under § 1.132. (Office Action p. 7.) Accordingly, while continuing all traverses and arguments in support of the same as presented in Applicant's prior filed Responses and Amendments, Applicant herein addresses the Examiner's responses to the Böttner enablement issue and disagreement.

Applicant's last-filed Response and § 1.132 Declaration, and all prior arguments filed are to be considered as continuing to be asserted. Applicant again traverses and files herewith a Notice of Appeal.

Summary:

In sum, the Examiner rejects Applicant's arguments and the § 1.132 Declaration of Paul. H. McClelland, both filed on September 1, 2010, as not persuasive as they pertain to the rejections relying on Migowski in view of Böttner. Specifically, the Examiner disagrees with Mr. McClelland's position that Böttner is not an enabling disclosure and as to what is considered undue experimentation. Essentially, the Examiner states that Mr. McClelland's statements in the § 1.132 Declaration concerning the Böttner reference are inaccurate or otherwise incorrect, and although complex and *per se* extensive experimentation may be necessary in attempt to make Böttner's merely named compounds, the complexity and extensive quantity of experimentation is not "undue." (Office Action, p. 7.) Applicant disagrees and believes that not only is Böttner non-enabling for the claimed devices, any experimentation would not only be undue but would be extensive and unpredictable.

Issues:

The Examiner asserts that Böttner enables one of ordinary skill in the art to make p-type and n-type thin film thermoelements, all on a single substrate, by cosputter deposition to form the compounds Bi_xTe_y, Sb_xTe_y, or Bi_xSe_y, wherein x and y form a non-stoichiometric compound, wherein x is about 2 and y is about 3. The Examiner also asserts that Böttner enables one of ordinary skill in the art to make tertiary p-type and n-type thermoelements, all on a single substrate, comprising all of Bi_xTe_y, Sb_xTe_y, and Bi_xSe_y, wherein x is about 2 and y is about 3. Additionally, the Examiner asserts that Böttner teaches how to make thermoelement thin films comprising Bi_xTe_y and Sb_xTe_y, or Bi_xTe_y and Bi_xSe_y. Applicant (and Declarant McClelland) disagree.

A. The Law of Enablement in Regard to Prior Art References

In order to act as anticipating or obviousness prior art, a reference must enable one of ordinary skill in the art to make the invention without undue experimentation. MPEP § 2121.01; *Impax Laboratories Inc. v. Aventis Pharmaceuticals Inc.*, 545 F.3d 1312 (Fed. Cir. 2008). In other words, the prior art must inform as to how to make the claimed invention. *Minn. Mining & Mfg. Co. v. Chemque, Inc. (3M)*, 303 F.3d 1294, 1301 (Fed. Cir. 2002).

The naming of a compound in a reference, without more, cannot constitute a description of the compound and the reference is not enabling prior art. One of ordinary skill in the art must be able to make or synthesize the compound for the reference to be considered enabling prior art for the teaching of the compound to be made. See, MPEP § 2121.02 and *In re Hoeksema*, 399 F.2d 269, 158 USPQ 596 (CCPA 1968). In *In re Kubin*, 561 F.3d 1351 (Fed. Cir. 2009) **the court further confirmed** the court's holding in *In re O'Farrell*, 853 F.2d 894 (Fed. Cir. 1988), **as reinvigorated by the court in *KSR*** (*KSR Int'1 Co. v. Teleflex, Inc.*, 127 S. Ct. 1727 (2007), **that the cited references must contain "detailed enabling methodology for practicing the claimed invention**, a suggestion to modify the prior art to practice the claimed invention, and evidence suggesting that it would be successful." (Emphasis added.)

Applicant understands that the test of enablement is not whether any experimentation is necessary, but whether, if experimentation is necessary, it is undue. There are, however, many factors the Examiner failed to consider when determining whether there is sufficient evidence to support a determination that Böttner satisfies the enablement requirement and whether the admittedly complex and necessary extensive experimentation is "undue." In *In re* Wands, 858 F.2d 736 (Fed. Cir. 1998), the Court indicated that the factors to be considered include, but are not limited to:

(i) The breadth of the claims;
(ii) The nature of the invention;
(iii) The state of the prior art;
(iv) The level of one of ordinary skill;
(v) The level of predictability in the art;
(vi) The amount of direction provided in the disclosure;
(vii) The existence of working examples in the disclosure; and
(viii) The quantity of experimentation needed to make the compositions based on direction provided in the disclosure.

It is improper for the Examiner to conclude that the Böttner reference is enabling for the cosputter deposited thin-film thermoelements formed of Bi_xTe_y, Sb_xTe_y, or Bi_xSe_y (claim 1) **or** for the making of thermoelement thin films comprising Bi_xTe_y, Sb_xTe_y, and Bi_xSe_y, (claim 3) **or** thermoelements comprising Bi_xTe_y and Sb_xTe_y, or Bi_xTe_y and Bi_xSe_y (all wherein x is about 2 and y is about 3) based on an analysis of only one of the above factors, while ignoring the others. The Examiner's analysis must consider all of the evidence related to each of these factors, and any conclusion of non-enablement of Böttner must be based on the evidence as a whole.

B. Evidence that Böttner is Not Enabling and Requires Undue Experimentation:

It is Applicant's view that based on all of the factors as discussed below, as well as the § 1.132 Declaration of one of ordinary skill in the art, if not an expert, Paul McClelland, Böttner is not enabling and any experimentation, in attempt to make the same, would be undue.

(i) The breadth of the claims – the Böttner reference does not teach or suggest the overall claimed device nor does the Examiner assert that it does. It must, however, teach how to make p-type and n-type thermoelements, all on a single substrate, by cosputter deposition to form the compound Bi_xTe_y, Sb_xTe_y, or Bi_xSe_y, wherein x and y form a non-stoichiometric compound, wherein x is about 2 and y is about 3 (per claim 1), the aspects of Applicant's claimed device that the Examiner admits Migowski fails to teach or suggest. Böttner also must enable the making of multiple tertiary p-type and n-type thermoelements, all on a single substrate, comprising all of Bi_xTe_y, Sb_xTe_y, and Bi_xSe_y, wherein x is about 2 and y is about 3, by cosputter deposition (claim 3 and other related claims).

(ii) The nature of the invention – both Böttner and Applicant's invention concern semiconductor, thin-film thermoelements.

(iii) The state of the prior art – the prior art of record does not teach or suggest the claimed thermoelectric devices and as made clear by the Examiner's citing of Böttner, there is no reference teaching or suggesting the thermoelectric devices having the claimed thermoelement thin-film compositions. To make up for the deficiency of the prior art, the Examiner came up with Böttner. Unfortunately, Böttner merely names one of the claimed compounds but doesn't give any guidance on how to make it. The Examiner, apparently in recognition of the fact that Böttner fails to give any guidance on how to make any of the claimed compounds, then cites a text book on physical vapor deposition processing, which text book, Mattox, discusses numerous parameters that can be manipulated when performing physical vapor depositions. There is no mention in Mattox as to the compositions in question nor how to make such compositions. Thus, no reference has been cited that teaches how to make the claimed thin-film thermoelements or even the composition from which they are formed.

(iv) The level of one of ordinary skill – the inventors of the present application are well educated.

(v) The level of predictability in the art – the level of predictability in the art is low, as the predictability of chemistry in general is low. In fact, the Böttner reference itself is about the difficulties in fabrication processes for suitable thermoelectric microdevices and focuses on wafer-

based fabrication processes for making Peltier devices, noting the difficulties encountered in doing so. Böttner itself notes the lack of understanding of certain of the actual growths made, such as noting undesirable cracking in part of the material grown without knowing how it occurred (p. 515) and stating in the Conclusion that the disclosed fabrication methods were "under development" – not known or developed – and that "progress may be expected" (p. 517). This all indicates that Böttner itself is evidence of the unpredictability of the art.

(vi) <u>The amount of direction provided by the disclosure</u> – there is <u>no</u> direction provided in Böttner as how to cosputter deposit the claimed thin-film compounds or thermoelements. As stated by Applicant in previous responses and by one that may be considered an expert in the field, Paul McClelland, in his § 1.132 Declaration, Böttner fails to enable the making of the claimed thin film compositions, at least in part because Böttner fails to provide any direction regarding at least the following sputter deposition parameters and methods:

- ✓ Power levels applied to targets,
- ✓ Magnitude of the atomic flux emitted from each target;
- ✓ Substrate temperatures required during deposition;
- ✓ Distances the targets are to be placed during deposition;
- ✓ Temperatures used to anneal the films to adjust properties as disclosed; or
- ✓ The approach used for growth of p-$(Bi,Sb)_2Te_3$ materials.
- ✓ Additionally Böttner does not disclose deposition of n-type and p-type material on one substrate but instead discloses a wafer-based system n-type material on a first wafer and p-type material on a second wafer.
- ✓ Böttner does not disclose how to make both n-type and p-type material simultaneously on the same wafer; and
- ✓ Böttner does not show any method that allows for the deposition of both n-type and p-type material on the same substrate.

(vii) <u>The existence of working examples</u> – there are <u>no</u> examples in the Böttner reference showing or describing how to make the claimed compounds or thin-film thermoelements.

(viii) <u>The quantity of experimentation needed based on the content of the disclosure</u> – as admitted by the Examiner, the cosputter deposition is a complex set of parameters, conditions and methodologies. Varying all these different parameters, conditions and methodologies, to make the claimed compounds and thin-film thermoelements with the desired physical characteristics, considering it from the standpoint of simple mathematics, *per se* illustrates the

extensive quantity of experimentation that was required for the Inventors to develop the disclosed invention.

Weighing the eight factors above, including that: the prior art completely lacks any teaching of the making of the compounds and thin-film thermoelectrics, extensive amounts of experimentation that would be necessary, Böttner has no examples, Böttner offers no direction or guidance on how to make the compounds, the art is <u>not</u> predictable, having a very complex nature, Böttner clearly requires undue experimentation and thus is not enabling for that which the Examiner cites it.

Regarding claim 3, the Examiner states that Applicant's arguments are correct – that Böttner does not disclose or even contemplate tertiary TE thin-film materials, which is also commented on in the § 1.132 Declaration, but nonetheless such would have been an obvious choice of multiple known thermoelectric materials. As with claim 1 discussed above, the Examiner fails to state any motivation, reason or drive to prepare Applicant's tertiary p-type or n-type thin film thermoelements other than Applicant's own disclosure. Furthermore, the Examiner has failed to offer a single reference showing the claimed tertiary p-type and n-type thin film thermoelements.

As to claim 5, the Examiner asserts that the choice of specific volume for the device number of thermocouples and resulting power output are dependent on specific application for the device and absent any unexpected results it would have been obvious of one of ordinary skill in the art at the time the invention was made. Applicant continues to disagree.

As discussed in many of the prior Office Action Responses the Migowski disclosure does not teach or suggest a TE power source capable of producing from 50 microwatts to 1 watt of electrical power and Böttner fails to make up for the deficiency of Migowski. The Examiner states that it is merely a matter of application of the device and that the choice of element length, width and thickness, etc. is known in the art to affect the power output available. The Examiner makes this mere conclusory statement with no cited reference or other support.

Furthermore the record in this application is replete with evidence that certain parameters of the present application, such as L/A ratios and the stoichiometry of the claimed TE thin film materials, are manipulated to produce the disclosed device having the claimed output and the criticality of such various device characteristics have been shown. All prior asserted arguments are re-asserted though not re-iterated herein.

Claim 5 is dependent on claim 1 and claim 1 recites certain of these features that allow the power output as claimed in claim 5. For at least these reasons and those discussed in relation to claim 1, claim 5 is allowable over the art of record and the Examiner's mere conclusory statement that it is obvious to vary such characteristics is not supported by the evidence or by any motivation other than Applicant's own disclosure.

The Examiner fails to comment on the arguments made by Applicant in its last response, in regard to claims 17 or 37-39.

Lastly we note that the § 1.132 Declaration of Paul. H. McClelland indicates that he is likely to be considered an expert, not just one of ordinary skill in the art in the field of chemistry, particularly in the field of physical vapor deposition chemistry. As Mr. McClelland declares, the Böttner reference enables only elemental sputtering not the necessary simultaneous co-sputtering needed to produce the non-stoichiometric compounds and thin-film thermoelements of the presently claimed invention.

Applicant respectfully requests withdrawal of the claim rejections.

Lastly, it is Applicant's position that Examiner's disregard for the expertise shown of Mr. McClelland in the art and field of physical vapor deposition and this expert's explanation in the § 1.132 Declaration of the fatal deficiencies of Böttner, is improper. A Notice of Appeal is being filed herewith.

Respectfully submitted,

KLARQUIST SPARKMAN, LLP

By

Lisa M. Caldwell
Registration No. 41,653

One World Trade Center, Suite 1600
121 S.W. Salmon Street
Portland, Oregon 97204
Telephone: (503) 595-5300
Facsimile: (503) 595-5301